(New)

86. An optical element producing method of producing an optical element having a microscopic pattern, comprising steps of:

drawing a predetermined pattern on a base material including a pattern-drawn layer on which the pattern is drawn,

wherein the pattern-drawn layer has a curved surface and the predetermined pattern is drawn by irradiating an electron beam onto the curved surface of the pattern-drawn layer.

(New)

87. The optical element producing method described in claim 86, wherein the predetermined pattern is formed by controlling an energy amount of the electron beam exposed on the base material.

(New)

88. The optical element producing method described in claim 87, wherein a depth formed at a point on the predetermined pattern is varied by controlling the energy amount of the electron beam exposed at the point.

(New)
89. The optical element producing method described in claim 88, wherein the energy amount of the electron beam exposed at the point is controlled within a depth of focus at a focus position of the electron beam.

(New)
90. The optical element producing method described in claim 86, wherein the focus position of the electron beam on the base material is adjusted by controlling an electron lens so as to shift a heightwise position of the focus position within a depth of focus.

(New)
91. The optical element producing method described in claim 86, wherein the electron beam is irradiated onto a resist layer on the base material.

(New)
92. The optical element producing method described in claim 86, further comprising the steps of:

forming a molding die on the basis of the base material on which the predetermined pattern has been drawn, and

producing an optical element by conducting an injection molding for the molding die.

(New)
93. The optical element producing method described in claim 86, further comprising the steps of:

developing the base material irradiated with the electron beam, and

conducting an electroforming process on the developed base material so as to form a molding die.

(New)
94. The optical element producing method described in claim 93, wherein the base material is subjected to an etching process before the electroforming process.

(New)
95. The optical element producing method described in claim 86, wherein the drawing step is conducted for a first base material and a second base material respectively, and the optical element producing method further comprising the steps of:

forming a first molding die and a second molding die respectively based on the first and second base materials;

assembling a mold by arranging the first and second molding dies to be opposite to each other; and

conducting an injection molding for the mold so as to form an optical element having a configuration corresponding the patterns drawn on the the first and second base materials.

(New)
96. The optical element producing method described in claim 95, wherein a polarized light splitting structure is drawn on one of the first and second base materials and a diffractive grating structure is drawn on the other base material.

(New)
97. The optical element producing method described in claim 95, wherein a birefringence phase structure is drawn on one of the first and second base materials and a diffractive grating structure is drawn on the other base material.

(New)
98. A pattern drawing method of forming a predetermined pattern on a base material including a pattern-drawn layer, comprising the step of:

drawing the predetermined pattern by irradiating an electron beam onto the pattern-drawn layer, wherein the pattern-drawn layer has a curved surface.

(New)
99. The pattern drawing method described in claim 98, wherein the predetermined pattern is formed by controlling an energy amount of the electron beam exposed on the base material.

(New)

100. The pattern drawing method described in claim 99, wherein energy amount of the electron beam is controlled in accordance with a dose.

(New)

101. The pattern drawing method described in claim 99, wherein a depth formed at a point on the predetermined pattern is varied by controlling the energy amount of the electron beam exposed at the point.

(New)

102. The pattern drawing method described in claim 101, wherein the energy amount of the electron beam exposed at the point is controlled within a depth of focus at a focus position of the electron beam.

(New)

103. The pattern drawing method described in claim 98, wherein the step of drawing is conducted by changing a focus position of the electron beam relatively to the base material.

(New)

104. The pattern drawing method described in claim 103, wherein the focus position is changed by adjusting the focus position of the electron beam.

(New)
105. The pattern drawing method described in claim 104, wherein the focus position of the electron beam on the base material is adjusted by controlling an electron lens so as to shift a heightwise position of the focus position within a depth of focus.

(New)
106. The pattern drawing method described in claim 105, wherein the focus position of the electron beam is adjusted by controlling a value of an electric current for the electron lens.

(New)
107. The pattern drawing method described in claim 103, wherein the focus position of the electron beam is changed by conducting a positional adjustment while moving the base material.

(New)
108. The pattern drawing method described in claim 103, wherein the focus position of the electron beam is changed by adjusting the focus position of the electron beam or by conducting a positional adjustment while moving the base material.

(New)
109. The pattern drawing method described in claim 108, further comprising a calculating step of calculating at least a heightwise position of a pattern-drawn position.

(New)
110. The pattern drawing method described in claim 109, further comprising a pattern drawing step of drawing a pattern on the pattern-drawn layer while conducting the adjusting the position.

(New)
111. The pattern drawing method described in claim 110, wherein the pattern drawing step comprises a step of drawing a pattern for at least a first field of a unit space in a three-dimensional reference coordinate system on the basis of the calculated pattern-drawn position and a step of drawing a pattern for a second filed while conducting again the calculating step and the position adjusting step after completing the pattern drawing step for the first field.

(New)
112. The pattern drawing method described in claim 109, further comprising a thickness distribution measuring step of measuring the thickness distribution of the base material beforehand.

(New)
113. The pattern drawing method described in claim 112, wherein the calculation step calculates at least the heightwise position of the pattern-drawn position on the basis of the thickness distribution of the base material.

(New)
114. The pattern drawing method described in claim 112, further comprising a thickness distribution measuring step of measuring the thickness distribution of the base material while irradiating the electron beam.

(New)
115. The pattern drawing method described in claim 112, further comprising the steps of:

a reference point measuring step of measuring positions of a plurality of reference points while irradiating the electron beam, and

a correcting step of correcting the thickness distribution on the basis of the positions of the plurality of reference points while irradiating the electron beam.

(New)
116. The pattern drawing method described in claim 115, wherein the thickness distribution measuring step includes a step of calculating a first three-dimensional reference coordinate system in the base material on the basis of the

plurality of reference points measured beforehand on the base material and a step of calculating at least a first heightwise position of the pattern-drawn position in the first reference coordinate system, and the correcting step includes a step of calculating a second three-dimensional reference coordinate system in the base material on the basis of a plurality of reference points measured when the base material is placed on a pattern drawing stage and a step of calculating a second heightwise position in the second reference coordinate system corresponding to the first heightwise position as a heightwise position of the electron beam at the pattern-drawn position.

(New)

117./The pattern drawing method described in claim 115, wherein the reference point measuring step includes a step of irradiating a light beam to the base material from a direction approximately perpendicular to the electron beam, a step of detecting a light intensity distribution passing through the base material on the basis of the light beam and a step of calculating the heightwise position of the base material on the basis of the light intensity distribution.

(New)
118./The pattern drawing method described in claim 115, wherein the reference point measuring step includes steps of irradiating a first light beam to the base material from a direction crossing the electron beam and detecting a first light intensity distribution reflecting from a flat portion of the base material on the basis of the first light beam; steps of irradiating a second light beam different from the first light beam to the base material from a direction substantially perpendicular to the electron beam and detecting a second light intensity distribution passing through the base material on the basis of the second light beam and steps of calculating a heightwise position of the flat portion on the basis of the first intensity distribution and calculating a heightwise position of a point on a curved surface portion projecting from the flat portion of the base material on the basis of the second intensity distribution.

(New)
119./The pattern drawing method described in claim 109, wherein the calculating step includes a step of calculating a first three-dimensional reference coordinate system in the base material on the basis of a plurality of reference points measured beforehand on the base material, a step of calculating at least a first heightwise position

of the pattern-drawn position in the first reference coordinate system, a step of calculating a second three-dimensional reference coordinate system in the base material on the basis of a plurality of reference points measured when the base material is placed on a pattern drawing stage, and a step of calculating a second heightwise position in the second reference coordinate system corresponding to the first heightwise position as a heightwise position at the pattern-drawn position of the electron beam.

(New)
120./The pattern drawing method described in claim 109, wherein the calculating step is carried out while irradiating the electron beam.

121. The pattern drawing method described in claim 108, wherein the position adjusting step is carried out while irradiating the electron beam.

(New)
122./The pattern drawing method described in claim 98, wherein the electron beam is irradiated to a resist layer on the base material.

(New)
123. The pattern drawing method described in claim 98, wherein the predetermined pattern to be formed on the pattern-drawn layer of the base material corresponds to a specific pattern on an optical element.

(New)
124. The pattern drawing method described in claim 123, wherein the specific pattern includes a diffractive grating structure.

(New)
125. The pattern drawing method described in claim 124, wherein the diffractive grating structure is formed on the basis of a predetermined dose distribution corresponding to a scanning position.

(New)
126. The pattern drawing method described in claim 125, wherein the characteristic of the dose distribution is defined beforehand.

(New)
127. The pattern drawing method described in claim 125, wherein the characteristic of the dose distribution is one that is extracted in accordance with an inclination angle of a slope on the curved surface portion.

(New)
128. The pattern drawing method described in claim 123, wherein the specific pattern includes a pattern for reducing surface reflection.

(New)
129. The pattern drawing method described in claim 128, wherein when concave and convex portions are formed for the pattern for reducing surface reflection, a dose distribution including a dose for a concave or convex portion is calculated for a scanning position on the basis of the characteristic of the dose distribution and a pattern drawing on the base material is carried out.

(New)
130. The pattern drawing method described in claim 129, wherein the characteristic of the dose distribution is defined beforehand.

(New)
131. The pattern drawing method described in claim 128, wherein the specific pattern includes a diffractive grating structure and the pattern for reducing surface reflection.

(New)
132. The pattern drawing method described in claim 131, wherein at least one pitch portion of a diffractive grating is formed with a tilt on the curved surface

portion of the base material and concave and convex portions for reducing surface reflection are formed for the one pitch portion.

(New)
133./The pattern drawing method described in claim 132, wherein the characteristic of the dose distribution is extracted in accordance with an inclination angle of a slope on the curved surface.

(New)
134./The pattern drawing method described in claim 132, wherein the one pitch portion of a diffractive grating comprises a side wall portion rising up on the base material at an end position of the pitch and a slope portion formed between neighboring side wall portions, and the concave and convex portions are formed on the slope portion.

(New)
135./The pattern drawing method described in claim 132, wherein the concave and convex portions comprise a large number of tapered hole portions.

(New)
136./The pattern drawing method described in claim 135, wherein pattern drawing is done so as to make a ratio of

the area of the hole portions to the area of the slope portion to be a predetermined ratio.

137. /(New) The pattern drawing method described in claim 131, wherein at least two pitch portions of the diffractive grating comprise a side wall portion rising up on the base material at an end position of the pitch and a slope portion formed between neighboring side wall portions, and a reflection reducing structure is formed on the slope portion so as to reduce reflection of a light beam entering the slope portion or emerging from the slope portion.

138. /(New) The pattern drawing method described in claim 131, further comprising the steps of

conducting a pattern drawing for the curved surface portion of the base material on the basis of the dose distribution for a scanning position at the time of forming at least one pitch of a diffractive grating with a tilt on the curved surface portion of the base material, and

conducting a pattern drawing of concave and convex portions on the basis of the dose distribution for the concave and convex portion at the time of forming the

concave and convex portions for reducing surface reflection for the one pitch of the diffractive grating.

(New)
139. The pattern drawing method described in claim 128, wherein the reflection reducing structure comprises a plurality of concave and convex portions having a function of structural birefringence.

(New)
140. The pattern drawing method described in claim 128, wherein the reflection reducing structure comprises a plurality of hole portions.

(New)
141. The pattern drawing method described in claim 140, wherein each of the hole portions has a tapered shape becoming smaller as being depper.

(New)
142. The pattern drawing method described in claim 140, wherein an opening diameter of the hole portions is shaped in an order of sub-micron.

(New)
143. The pattern drawing method described in claim 128, wherein the reflection reducing structure has a structure to reduce the reflection of a light beam being incident or outgoing.

(New)
144. The pattern drawing method described in claim 123, wherein the specific pattern includes a polarized light splitting structure.

(New)
145. The pattern drawing method described in claim 144, wherein the polarized light splitting structure has a nearly concave and convex shape in a cross-section and has an approximately circular shape in a plan.

(New)
146. The pattern drawing method described in claim 145, wherein, in the polarized light splitting structure, a first convex portion having a first width and a second convex portion having a second width different from the first width are formed plural sets with an interval.

(New)
147. The pattern drawing method described in claim 145, wherein, in the polarized light splitting structure, a first concave and convex portion and a second concave portion are formed alternatively, and wherein a first convex portion having a first width and a first concave portion having a second width different from the first width are alternately formed in the first concave and

convex portion and the second concave portion has a third width different from the first width and the second width.

(New)
148. The pattern drawing method described in claim 144, wherein the polarized light splitting structure has such a structure as to split an incident or outgoing light beam into at least two polarized light components oscillating in directions perpendicular to each other on a plane crossing a proceeding direction of the light beam.

(New)
149. The pattern drawing method described in claim 144, wherein the polarized light splitting structure has such a structure as to split a parallel light flux into a plurality of light fluxes composed of P polarized light and S polarized light having optical paths close to each other respectively.

(New)
150. The pattern drawing method described in claim 123, wherein the specific pattern includes a birefringence phase structure.

(New)
151. The pattern drawing method described in claim 150, wherein the birefringence phase structure has a concave

and convex shape in a cross-section and an approximately circular shape in a plan.

(New)
152./The pattern drawing method described in claim 151, wherein in the birefringence phase structure, a convex portion having a first width and a concave portion having a second width shorter than the first width are alternately formed.

(New)
153./The pattern drawing method described in claim 150, wherein the birefringence phase structure is such a structure that produces a phase difference between one linearly polarized light flux and the other linearly polarized light flux among incident or outgoing linearly polarized light fluxes oscillating in directions perpendicular to each other respectively.

(New)
154./The pattern drawing method described in claim 150, wherein the birefringence phase structure is such a structure that produces a phase difference between light fluxes comprising at least a P polarized light flux and a S polarized light flux among a plurality of light fluxes.

(New)

155. A pattern drawing apparatus for forming a predetermined pattern on a base material having a pattern-drawn layer, comprising:

a moving device to move a focus position of an electron beam relatively for the base material in accordance with the pattern-drawn layer having a curved surface, and

an electron beam irradiating device to conduct drawing a predetermined pattern by irradiating an electron beam to the patter-drawn layer.

(New)

156. The pattern drawing apparatus described in claim 155, wherein the electron beam irradiating device comprises an electron lens for making variable the focus position of an electron beam emitted by the electron beam irradiating device and the moving device controls variably the focus position of the electron beam by adjusting an electric current value of the electron lens in accordance with a pattern-drawn position on the base material.

(New)

157. The pattern drawing apparatus described in claim 155, further comprising:

a carrying table on which a base material having a pattern-drawn curved surface is placed, and

a driving device to drive the carrying table,

wherein the moving device controls the driving device so as to move up or down the carrying table so that the focus position of the electron beam is variably controlled in accordance with the pattern-drawn position on the base material.

(New)

158. The pattern drawing apparatus described in claim 155, further comprising a measuring device which comprises:

a first optical system to irradiate a first irradiation light beam to the base material from an oblique direction and to receive a first transmitting light beam having transmitted through the base material;

a second optical system to irradiate a second irradiation light beam to the base material from an approximately horizontal direction and to receive a second light transmitting beam having transmitted through the base material;

a calculating device to calculating a heightwise position of the pattern-drawn position on a flat portion of the base material on the basis of a first light intensity distribution detected by the first optical system and to calculate a heightwise position of the pattern-drawn position on a curved portion projecting from

the flat portion of the base material on the basis of a second light intensity distribution detected by the second optical system.

(New)
159./The pattern drawing apparatus described in claim 155, further comprising a second measuring device to measure positions of reference points on the base material previously before the base material is placed in the apparatus.

(New)
160./An optical element produced by a method set forth in claim 86.

(New)
161./The optical element described in claim 160, comprising a diffractive grating structure on a curved surface.

(New)
162./The optical element described in claim 161, further comprising a pattern for reducing surface reflection on the curved surface.

(New)
163./The optical element described in claim 162, wherein at least one pitch portion of a diffractive grating is formed with a tilt on the curved surface portion of the

base material and concave and convex portions for reducing surface reflection are provided for the one pitch portion.

(New)
164. The optical element described in claim 163, wherein the one pitch portion of the diffractive grating comprises a side wall rising up at one end position of the one pitch portion and a slope portion formed between neighboring side walls, and the concave and convex portions are provided on the slope portion.

(New)
165. The optical element described in claim 163, the concave and convex portions are composed of a large number of tapered hole portions.

(New)
166. An optical element produced by a method set forth in claim 95.

(New)
167. The optical element described in claim 166, comprising a diffractive grating structure on a surface of one side and a polarized light splitting structure on a surface of the other side.

(New)
168. The optical element described in claim 166, comprising a diffractive grating structure on a surface of

one side and a birefringence phase structure on a surface of the other side.

(New)

169./The optical element described in claim 166, comprising a birefringence phase structure on a surface of one side and a polarized light splitting structure on a surface of the other side.

(New)

170./A base material formed by a method set forth in claim 98.